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High energy particle collisions and geometry of horizon

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Abstract

© 2016 World Scientific Publishing Company.We consider collision of two geodesic particles near the lightlike surface (black hole horizon or naked singularity) of such an axially symmetric rotating or static metric that the coefficient $g_{\varphi\varphi} \to 0$ on this surface. It is shown that the energy in the center of mass frame Ec.m. is indefinitely large even without fine-tuning of particles' parameters. Kinematically, this is the collision between two rapid particles that approach the horizon almost with the speed of light but at different angles (or they align along the normal to the horizon too slowly). The latter is the reason why the relative velocity tends to that of light, hence to high Ec.m. Our approach is model-independent. It relies on general properties of geometry and is insensitive to the details of material source that supports the geometries of the type under consideration. For several particular models (the stringy black hole, the Brans-Dicke analogue of the Schwarzschild metric and the Janis-Newman-Winicour one) we recover the results found in literature previously.

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Keywords

horizon, kinematics, Particle collision